ABSTRACT

The present invention relates to beam steering and scanning devices which utilize cholesteric liquid crystal (CLC) elements arranged in branches to form a logic tree. Each branch comprises an active and passive CLC element; the former further comprising a half-wave retarder and an electrode and the latter only the CLC element. Each succeeding branch contains twice as many branches as a preceding branch and, by activating active CLC element electrodes under control of a programmable pulsed source, inputs applied to the first stage of a logic tree are delivered as a scanned line of electromagnetic energy or light to the imaging cells of the last stage of the logic tree. By stacking identical logic trees with a laser source for each tree, a flat panel imaging array or display device is formed in which the transmission losses are minimized.

Using a similar imaging array, transmission losses may be further reduced by using a logic tree the outputs of which act as inputs to the imaging array where formerly a plurality of lasers were required. By positioning an input logic tree perpendicularly to the similar logic trees of the imaging array, a single source of energy provides an output at each of its imaging cells which acts as an input to an associated logic tree of the imaging array. 2-D and 3-D images are provided by applying modulation to lasers from standard T.V. cameras and cameras designed to provide stereo displaced images respectively. In the array which provides 3-D images, an image and a stereo displaced image are interleaved to provide the desired images each of which has a different circular polarization.

The present invention also relates to a method of fabricating structures which provide the above described features. Since all the stages of a logic tree differ only in the number of branches they contain, it was recognized that light beams, for example, applied from a laser beam could pass through a number of stages with minimum dispersion and maintain its original position even though relatively large structures are used to control its position. This recognition permitted the use of CLC elements, electrodes and half-wave retarder

material which need not be divided into discrete elements in each logic tree. Thus, each CLC element, each electrode, each retarder material may extend from top-to-bottom or from side-to-side in each stage of an imaging array.

Stages are fabricated by slicing layers of insulating material and CLC material at an angle of 45°. The thickness of the insulating material controls the spacing between the resulting CLC elements. Transparent layers, such as indium tin-oxide are formed on both sides of the layer or layers containing spaced CLC elements. Using photolithographic techniques, one side is masked and etched to form an electrode over every other CLC element. A spacer element fixed to the periphery of each layer where the electrodes have been etched forms a volume into which half-wave retarder material is introduced in liquid form. In this way, stages containing two, four, eight, sixteen, CLC elements and so on have been massed produced. The stages are then stacked so that each stage contains twice as many CLC elements as a preceding stage forming logic trees the imaging cells of which form an array.

The above described arrangements and their fabrication technique provide flat panel displays which substantially reduce transmission losses and the number of energizing sources. These features combined with a novel and inexpensive manufacturing technique are able to deliver a flat panel display which requires neither a vacuum envelope nor unacceptable high voltages.